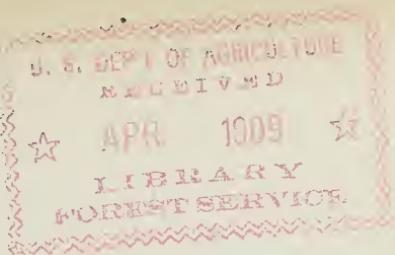


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B. T. GALLOWAY, Chief of Bureau.

CLOVER-SEED PRODUCTION IN THE WILLAMETTE VALLEY, OREGON.

BY
BYRON HUNTER,
ASSISTANT AGRICULTURIST, OFFICE OF FARM MANAGEMENT.

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CLOVER-SEED PRODUCTION IN THE WIL- LAMETTE VALLEY, OREGON.^a

INTRODUCTION.

When first brought into cultivation, the soils of the Willamette Valley were friable, quite easily tilled, and productive. For forty or fifty years the cereal crops were grown almost exclusively. As the soil became infested with weeds, summer fallowing became a common practice. This system of tillage and the continuous growth of cereal crops year after year depleted the soil of much of its vegetable matter and rendered it heavier, more lifeless, and more difficult to work. When this condition was reached the productiveness of the soil was greatly reduced and the exclusive production of cereals became unprofitable. Farmers turned their attention to the growing of clover, but they found it difficult to get satisfactory stands.

Dr. James Withycombe, in Bulletin No. 76 of the Oregon Experiment Station, says:

Although western Oregon is so well adapted to the growing of clover, numerous failures are annually recorded. In fact these failures were so general in the past that it was popularly believed clover could not be successfully grown upon the ordinary prairie soils of the valley.

In spite of this belief, however, the persistent efforts of numerous farmers in different parts of the valley and the work of the Oregon Experiment Station have proved its fallacy and gained for both red and alsike clover a very prominent place in the agriculture of western Oregon.

^a In connection with the study of problems in farm management many important details of farm practice are learned by the men in charge of this work. This circular sets forth in detail successful farm practice in growing red and alsike clovers as seed crops, giving soil types and conditions under which each is grown, methods of securing stands, and rotations used in growing clover, and calls special attention to the method used in western Oregon of pasturing or clipping clover in order to delay the harvest and thus increase the yield of seed. This paper is a continuation of studies on commercial seed production from ordinary farm crops, of which Bulletin No. 100, Part VI, of this Bureau, by R. A. Oakley, on Orchard Grass, is the initial number.—B. T. GALLOWAY, *Physiologist and Pathologist, and Chief of Bureau.*

At first clover was grown for hay and pasture. Seed production in a commercial way did not begin until about six or seven years ago. The quality of seed now produced is excellent. The seed is large, nicely colored, and of good vitality. The yield of seed, as noted elsewhere, is good and its production has steadily increased until one may now see in many localities the clover huller making its neighborhood run instead of the thrashing machine of former years. Not only is clover a very profitable hay and seed crop but in conjunction with live-stock production it is having a marked influence in building up the fertility of the soils that were so long used for the exclusive production of wheat and oats.

TYPES OF SOILS IN THE WILLAMETTE VALLEY.

The purpose of the discussion of types of soils given herewith is to point out the soil conditions under which these two clovers, red and alsike, are grown. No attempt is made at an elaborate description of the soils of the valley. For further study of these types of soil, see Survey of Salem Area, Bureau of Soils.

There are two types of soils in the Willamette Valley upon which practically all of the clover is grown. The first, a reddish yellow clay, usually underlaid to about 3 feet by a clay of the same color, occupies the rolling hills of the valley. This type of soil is well drained, and level areas are very rarely found. It is well adapted to the growth of red clover. The second, a light brown to black loam, occupies the level prairie areas. It usually extends a short distance up the slopes of the hills, the topography being either level or very gently rolling. The level areas have very poor drainage, and water stands on the surface of the ground during much of the long wet season. When the surface soil of these low areas becomes dry during the annual summer drought it assumes a very light color, and for this reason it is locally known as "white land." This soil is poorly adapted to red clover, because the seed crop does not fill well.

Where this light-brown to black loam type is slightly rolling, the surface of the higher areas has a very much darker color than the white land. A foot of elevation may completely change the color of the soil. Because wheat will fill on this dark soil and not on the white land it is often spoken of as "wheat land." Where these two soils occur together in irregular areas they are often spoken of as "mixed land." The dark-colored wheat land is adapted to both red and alsike clover.

Farmers usually grow red clover in preference to alsike where it is possible to do so. Alsike will grow, however, under much wetter conditions than red clover. For this reason red clover is grown on the hilly clay soil and on the dark wheat land of the brown to black

loam type, while alsike occupies the white land and much of the mixed land. In addition to this, alsike is grown on the overflow land along some of the water courses where it is too wet for red clover.

THE SEED YIELD OF RED CLOVER.

The usual yield of red clover is from 4 to 6 bushels of seed per acre. When grown on poor soil and under unfavorable conditions, the yield may be less than this, while on the best of soils with a favorable season the yield may run as high as 7, 8, or 9 bushels per acre. When grown on the same kind of soil, alsike is said to yield a little better than red clover. On the poorest soil, the white land, where red clover is rarely planted, alsike yields from 2 to $2\frac{1}{2}$ bushels per acre; on the mixed land from 3 to 5 bushels; and on the dark, waxy overflow land along the South Yamhill River from 6 to 16 bushels. Mr. Horace Wood, who owns a farm and runs a huller in Yamhill County, reports the hulling of 5 acres of alsike on the bottom land of the South Yamhill River that yielded 80 bushels, or 16 bushels per acre. On his own farm the yields have been from 6 to 12 bushels per acre. Large yields like these, however, must be expected only under the most favorable conditions.

MEANS OF SECURING A STAND OF RED CLOVER.

There are so many different soil conditions in the Willamette Valley that no one way of sowing clover can be said to be most successful. As a result of poor drainage and years of continuous growth of the cereal crops the physical condition of some of the soils is very poor. Before attempting to start clover on such land vetch is often grown for about two seasons. Vetch materially improves the physical condition of the soil and builds it up in nitrogen. Following vetch, clover can usually be started without much difficulty. The white land is poorly drained and especially deficient in humus. What it needs is (1) tile drainage and (2) liberal applications of barnyard manure. Where this is impossible very satisfactory results are usually secured by throwing the land into ridges. This is done by plowing in lands by the backfurrow and dead-furrow system. The dead furrows are left open to carry off the surface water. With the land ridged in this way alsike clover does fairly well.

The following are some of the means used in starting clover.

Clover alone or with rapé.—On the white land, the mixed land, and in fact on almost all classes of soils, sowing clover with rape in the late spring—late in May or early in June—is very successful and popular. Some prefer to sow the clover alone. When this method is employed the white land is plowed in the early spring as soon as it is

in good working condition. If plowed in the fall it usually runs together and becomes so hard during the winter that it is necessary to replow in the spring. The darker, better soils are plowed any time during the winter when not too wet. The soil is worked up in the early spring and kept well cultivated until seeding time to hold the moisture, destroy weeds, and preserve the proper tilth. The white land is usually sown a little later than the better drained soils, because the late spring rains that come after seeding might be sufficient to cause the soil to run together.

From $1\frac{1}{2}$ to 3 pounds of rape and 5 pounds of alsike or 8 to 10 pounds of red clover per acre are sown broadcast the last of May or early in June. It is better to have the rape too thin than too thick, for when thick it makes but little growth. The seed is usually covered with a harrow. When the rape is from 8 to 12 inches high it is pastured with sheep or swine. During the late fall or next spring the field may be pastured closely to kill the rape. If rape is eaten off very closely to the ground it usually dies.

Clover sown alone on stubble land in the early fall.—This method of sowing clover is becoming quite popular. Land that is plowed a little late in the spring gives better results than land that is plowed early. The spring rains pack the early plowed land too much. Some farmers harrow to cover the seed, while others do not. If the seeding is done early in September, so that the young plants will have time to make considerable growth before the beginning of winter, excellent stands are usually secured. The stubble gives considerable protection during the winter and the ground does not heave so much as it would were it bare and worked up fine. Clover sown in the stubble in this way makes a fair crop the next season if it is given a good application of land plaster in the early spring.

Clover sown with spring grain.—On rich land that is in good condition or that has successfully produced clover, very good results are secured by sowing clover in the early spring with oats or wheat. From 30 to 40 pounds of land plaster to the acre applied to the surface of the ground at seeding time or after the young clover has leaved out stimulates the clover and makes the stand more certain. Clover is also frequently sown in February or March on winter wheat. Some of the clover growers who practice this method cut the grain crop just as high as possible in order to leave plenty of stubble. After the grain crop is removed from the field the stubble is mowed and left on the ground until spring, when it is removed. The stubble protects the clover from the sun during the latter portion of the summer and lessens the heaving of the ground during the winter. If a full stand is not secured from the spring seeding, more seed can be sown in the stubble in the fall.

Summer fallowing.—To get a stand of clover on land that has had its productiveness greatly reduced by years of continuous production of wheat and oats, that is full of sorrel, French pink, and other weeds, and that has never grown clover, some farmers resort to summer fallowing. The objects in summer fallowing are to rid the soil of weeds, to keep it in a moist, mellow condition, so that there will be more active bacterial action in the soil, and to make more plant food available with which to start the crop. In summer fallowing the ground is kept thoroughly cultivated all summer. After destroying the weeds that start in the fall a full crop of winter wheat or winter oats is sown with the disk drill. In some instances the drill will destroy the weeds without other cultivation. From 8 to 10 pounds of red clover or 5 pounds of alsike per acre are sown on the surface of the ground just as the drill leaves it. Instead of sowing with wheat or oats the clover is sometimes sown with a bushel of vetch seed per acre. The vetch crop is used for hay. Clover is sometimes sown alone in the early fall on land that has been summer fallowed. If a poor stand results from sowing alone or with grain in the early fall more seed may be sown in the early spring, during February or March.

None of these methods of sowing clover can be said to be entirely successful under all conditions. They may all fail at times. The one to use is the one that most nearly meets the needs of the individual farmer, that is, that suits the condition of his soil and permits him to get his land into clover most quickly or at the time he wants it.

CROP ROTATIONS PRACTICED BY GROWERS OF CLOVER.

The following are some of the rotations used by the clover growers in the Willamette Valley:

CROP ROTATION 1.

First year.—Clover, sown with rape or alone in the spring. Used for pasture the first summer and fall.

Second year.—Clover, used for pasture, hay, or seed.

Third year.—Clover, used for pasture, hay, or seed.

Fourth year.—Wheat or oats, with clover sown in the grain.

CROP ROTATION 2.

First year.—Cultivated crop, corn or potatoes.

Second year.—Wheat or oats, with clover sown in the grain.

Third year.—Clover, used for pasture, hay, or seed.

Fourth year.—Clover, used for pasture, hay, or seed.

CROP ROTATION 3.

First year.—Oats. Clover sod plowed and sown to oats in the spring.

Second year.—Vetch. Oat stubble disked in fall and sown to vetch.

Third year.—Wheat and clover. Vetch stubble disked in fall and sown to wheat and clover.

Fourth year.—Clover, used for pasture, hay, or seed.

Fifth year.—Clover, used for pasture, hay, or seed.

Sixth year.—Clover. If the stand is poor at the end of the fifth year, the clover is plowed up and oats sown again.

In this rotation it will be seen that the land is plowed but once in five or six years. This rotation is not in general use.

In actual practice these rotations are modified to meet the existing conditions which control the length of time that clover will produce profitably. In some instances it lasts but one season on account of the ravages of the clover root-borer. English plantain, or rib-grass, is a serious weed where clover occupies the land for a number of years. About the only way to keep it under control is to leave the clover down for about two years and then raise other crops for at least that length of time. Where these pests are not serious some farmers have been able to use their clover for five or six years by sowing a little seed on the clover sod in the early fall of each year to thicken it up.

PASTURING AND CLIPPING CLOVER.

Experience has taught the clover-seed producers that the first crop, especially that of red clover, yields a very small quantity of seed if allowed to mature naturally. If the first crop is used for hay, the dry season usually cuts the second crop so short that it amounts to very little for seed. For this reason it has become almost a universal practice to retard the development of the first crop by pasturing it in the spring. All classes of stock are used for this purpose, but sheep are preferable because they eat sorrel and many other weeds that most animals leave.

If it is impossible to pasture the clover, or if there are not enough stock to eat it off closely, it is clipped with a mower. The sickle bar of the mower is set to run low in order to get any sorrel that may have gone to seed, and the clippings are left on the ground. Even if the clover has been pastured pretty closely there are usually areas here and there over the field that the stock have left. To set these areas back and make the clover come on evenly, many farmers make a practice of running the mower over the field after removing the stock.

It is difficult to determine just how late in the spring to pasture or clip clover in order to get the heaviest yield of seed. In practice this date varies among the different seed growers from May 1 to June 20. The season has considerable to do with it. If the spring is backward and wet, the clover is pastured a little later than usual. On the other hand, if the spring opens up early and the ground begins to dry up, the stock are removed a little earlier. Owing to the impossibility of knowing what kind of weather is to prevail during the latter por-

tion of spring after the stock have been removed or the field clipped, the decision of this date is a matter of chance.

A good deal also depends on the type of soil upon which the clover is grown. Farmers who raise clover seed on the poorer soils, the white land and the mixed land, usually remove their stock earlier than those on the better types of soil, where the stock often remain on the clover until June, and in some instances as late as June 20. On the better, well-drained soils the growth is naturally heavier, and it is reasonable to assume that the pasturing should be continued a



FIG. 1.—Field showing the effect of land plaster on clover. The dark streaks on each side show the heavy growth of the clover where the plaster was applied. On the light streak in the center of the figure where no plaster was applied the growth of clover was very scant.

little later than on the poor land. A heavy, rank growth is seldom well filled. For a seed crop, growers usually want a medium growth that stands up well.

THE USE OF LAND PLASTER IN GROWING CLOVER.

Land plaster, or gypsum, has a wonderfully stimulating effect upon the growth of clover and other legumes in the Willamette Valley. (See fig. 1.) If applied as a top-dressing to clover sod early enough in the spring to be dissolved and washed into the soil by the

rain, it produces a healthy green color and materially increases the yield of both hay and seed. Untreated clover, on the other hand, is often very much stunted, yellowish, and sickly looking. The moist, mild climate is favorable to the growth of grasses and sorrel and other weeds which have a strong tendency to choke out the clover when no plaster is used. When land plaster is evenly distributed on clover sod in the early spring, the clover grows vigorously and its ability to hold the weeds and grasses in check is increased.

There are three principal reasons, then, for using plaster in clover-seed production, viz, to increase the yield of seed, to increase the amount of pasturage, and to hold the weeds under better control. To attain these ends in the fullest measure, however, it is essential that the plaster be applied early enough in the spring to be dissolved by the rain and that it be evenly distributed over the surface of the entire field.

In securing a stand of clover, the application of 30 to 40 pounds of land plaster to the acre at the time of seeding or after the clover is well up and leaved out has been found very beneficial. The stimulation it gives enables the young clover to withstand the summer drought better and to make a heavier growth, and therefore more pasturage, in the fall.

For hay where a full crop is desired the amount of plaster used varies from 50 to 100 pounds per acre. While this is a small amount of plaster to use, even less is used for a seed crop. While a few farmers apply as much as 75 to 100 pounds per acre for a seed crop, from 30 to 40 pounds is generally considered sufficient. Heavy applications usually produce too much straw. The plaster is usually applied during February, March, or early in April. One very successful seed grower, Mr. Clarence Koon, of Lane County, pastures his clover heavily with sheep until about May 1 and then applies 100 pounds of plaster per acre. By applying the plaster at this time when everything is eaten off closely, he thinks the clover will receive the full benefit of the plaster, grow more rapidly, and have a better chance to crowd out the weeds. For methods of applying land plaster the reader is referred to Circular No. 22, Bureau of Plant Industry, United States Department of Agriculture.

HARVESTING CLOVER FOR SEED.

Clover is not usually cut for seed until it is fairly ripe. Most seed growers wait until practically all of the heads have turned a dead brown color, but not until they have begun to fall to pieces. If cut a little green the heads do not ripen properly and much of the seed is shriveled and light. When the crop is left until it is thoroughly ripe, the cutting is done when the straw is damp with dew. Heavy

dews occur almost every night, which afford excellent conditions for cutting. The cutting is done in the late evening by moonlight and in the early morning until about 9 o'clock.

In cutting, the mower with the side-delivery buncher attached is generally used. (See fig. 2.) This leaves the swath in bunches behind the machine so that it is not trampled on by the horse or run over by the wheels of the mower in cutting the next swath. Sometimes the bunching device, which is tripped with the foot, is not used and the attachment to the sickle bar is then often spoken of as the "swather" because it turns the swath out into a roll behind the machine. When cut in this way the clover is usually raked into windrows before it becomes dry.

The self-rake reaper is perhaps the most satisfactory machine with which to cut a crop of seed clover. If the clover stands up well it can be cut much higher with the reaper than with the mower, thereby leaving more of the straw on the ground. This is an important point,

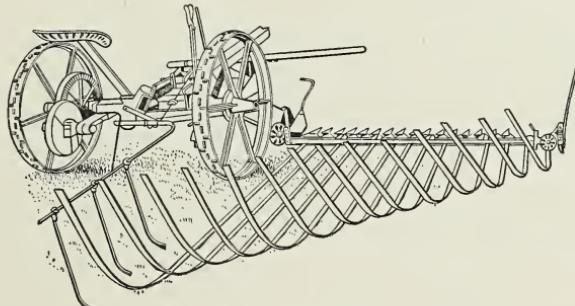


FIG. 2.—The side-delivery buncher. Delivers crop to one side, out of the way of the team and machine on the next round.

for it saves a great deal of labor in hauling and hulling the crop. If the clover has lodged, the reaper is set to cut as low as possible. The rakes of the reaper pull the fallen clover up to the sickle so that it is cut as closely with the reaper as with the mower. By driving the reaper slowly the bunches are dropped with the heads turned up and the butts down. In this condition the seed dries out nicely. If the driving is rapid, on the other hand, the butts of the bunches will be thrown up and the heads underneath.

The bunches from the reaper are dropped in rows across the field, where they remain undisturbed until hauled to the huller. In hauling the clover to the machine a bunch is picked up at one forkful with a large four-tined fork with very little shattering. When the clover is cut with the mower, raked into windrows, and hauled from the windrow to the huller, considerable seed is lost from shattering. The windrow is usually rolled up into bunches in order to get the proper sized forkfuls, and this shatters out much of the seed. Hay-

racks used in hauling clover to the huller should always be covered with canvas or provided with tight bottoms, for a great deal of seed is lost when hauled in open racks.

If the weather is favorable clover is ready to hull in six or eight days after it is cut. Practically all of the clover seed produced in the valley is hauled from the field as it is hulled. Stacking is said to be unsatisfactory. As previously stated, dews are heavy and the hullers can not usually run until 9 or 10 o'clock in the morning. Light showers on the clover as it lies in the field are said to be beneficial in that they make the hulling easier. Heavy showers and protracted rains may necessitate turning the bunches or windrows over to dry them out. If this is not done some of the seed will sprout.

TREATING CLOVER SEED AFFECTED WITH HONEY DEW.

Honey dew is a sticky substance secreted by plant lice which sometimes work on clover. When clover seed is affected with honey dew it is first run through a fanning mill or other cleaner to remove the seed that is not stuck together. That which is stuck together goes over the riddles with the coarse trash. This seed, together with the trash, is put into water to dissolve the honey dew, which requires a very short time. The water is then drained off and the seed and trash spread out on a canvas or floor to dry. After it is dry it is run through the cleaner again.

INSECT PESTS OF RED CLOVER.

For information regarding the insect enemies of red clover the reader is referred to circulars of the Bureau of Entomology, No. 67, entitled "The Clover Root Borer," and No. 69, entitled "Some Insects Affecting the Production of Red Clover Seed." These circulars may be obtained free of charge by addressing the United States Department of Agriculture, Washington, D. C.

HOW CLOVER-SEED PRODUCTION AND LIVE STOCK IMPROVE THE SOIL.

The system of growing clover seed in connection with live-stock production practiced in the Willamette Valley is very beneficial to the soil. As soon as the seed crop is removed the field is used for pasture, except when the ground is too wet, until the following May or June. The total time that the land is used for pasture varies from six to nine months. The manure that accumulates during the winter and the droppings from the animals when pasturing add no small amount of humus and plant food to the soil.

Clover occupies the land for two or more years. During this time the roots penetrate the soil to a considerable depth. When these roots decay channels are left leading down into the soil below. These channels permit the air and rain water to penetrate the soil more freely. Being a leguminous crop, clover adds more nitrogen to the soil than the crop removes. The stubble and other waste material on the surface of the ground, together with the roots, add a large amount of vegetable matter to the soil when the sod is plowed.

The following results secured by farmers who grow clover and pasture it with sheep and other live stock illustrate how this type of farming increases the productiveness of the soil. The data are incomplete and do not show conclusively that the increased yields are wholly due to the clover and live stock. Other factors may have exerted an influence. However, the beneficial effect of this type of farming on the texture and productiveness of the soil is too well established to need further comment.

The experience of Mr. C. R. Widmer, of Benton County, Oreg., is summarized as follows:

1904. Winter wheat. Red clover sown in the wheat February or March, 1905.

1905. Wheat. Yield, 7 bushels per acre. Clover made a good stand.

1906. Clover. Yield of seed, 5 bushels per acre.

1907. Clover. Clipped too late. Yield, 1 bushel of seed per acre.

1908. Oats. Land plowed in fall and sown in spring. Yield, 70 bushels per acre.

Mr. William Goffrier, until lately of Yamhill County, Oreg., rotated clover on two fields of 60 and 40 acres, respectively, with the following results:

1901. Wheat. Red clover sown in the wheat in February. Yield, 18 bushels per acre.

1902. Clover. Yield of seed, 7 bushels per acre.

1903. Clover. Yield of seed, 6 bushels per acre.

1904. Clover. Yield of seed, 4 bushels per acre.

1905. Oats. Yield, 80 bushels per acre.

1906. Wheat. Yield, 30 bushels per acre. Clover was sown with the wheat.

1907. Clover. Yield of seed, 4 bushels per acre.

1903. Wheat. Yield, 17 bushels per acre. Red clover sown in wheat.

1904. Clover. Yield of seed, 6 bushels per acre.

1905. Clover. Yield of seed, 6½ bushels per acre.

1906. Oats. Yield, 65 bushels per acre.

1907. Wheat. Yield, 27 bushels per acre.

Mr. Henry Zimmerman, of Linn County, Oreg., rotated alsike clover on a 14-acre field of "mixed land." The record of the yields follows: *

1906. Alsike clover. Sown alone in June. Pastured late summer and fall.

1907. Alsike clover. Yield of seed, 5½ bushels per acre. Plowed up in fall of 1907.

1908. Oats. Yield, 38 bushels per acre. A field of oats just across the fence made 25 bushels per acre on the same kind of land which had never been in clover.

Under date of November 30, 1908, Mr. Zimmerman writes:

I am plowing a piece of land that had been seeded to clover a second time. It is astonishing how much more mellow and light the ground now is than it was when plowed after the first seeding.

SUMMARY.

(1) The productiveness of much of the soil of the Willamette Valley has become so impaired by the continual growth of wheat and oats that the exclusive production of these crops is unprofitable.

(2) It has been found that clover-seed production on these soils is not only profitable, but that it increases their productiveness very materially as well.

(3) Red clover is grown on the better, well-drained soils, and alsike clover on those that are low and poorly drained.

(4) The average yield of red clover seed is from 4 to 6 bushels per acre. When grown under similar conditions alsike clover yields a little more than this.

(5) Stands of clover are secured by sowing it (1) alone or with rape during May and June; (2) alone in the stubble in the early fall; (3) in February, March, or April with spring grain or in winter wheat; and (4) after summer fallowing.

(6) In the rotation clover occupies the land as long as the stand is good. On account of the clover root-borer and of sorrel, plantain, and other weeds, clover is not usually a profitable crop for more than two or three years.

(7) If allowed to mature naturally, neither the first nor the second crop of red clover is profitable for seed. The best yields of seed are obtained by retarding the growth of the first crop by pasturing or clipping.

(8) Light applications of land plaster to clover sod increase the yield of both hay and seed. For a seed crop the amount applied per acre varies from 30 to 100 pounds. From 30 to 40 pounds per acre is the usual quantity used.

(9) Clover is cut for seed when practically all of the heads have turned a dead brown color, but before they have begun to fall to pieces. The mower with the side-delivery buncher attached is generally used in cutting. The self-rake reaper is used by some and is considered more efficient for this purpose.

(10) Clover seed that is stuck together with honey dew is successfully separated by washing it in water to dissolve the dew. After washing, it is dried and cleaned in the ordinary way.

(11) Farmers have found that their land yields much larger crops of wheat and oats after it has been in clover for two or more years. They also find that the texture of the soil is much improved, the soil being looser and more mellow.

Approved:

JAMES WILSON,

Secretary of Agriculture.

WASHINGTON, D. C., March 15, 1909.

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